

What is claimed is:

1. A morphing airfoil system for an aircraft, the system comprising:
a first airfoil having a first root, a first span, a first chord, and a first tip, the first
airfoil being attachable to an aircraft near the first root;
5 a second airfoil having a second root, a second span, a second chord, and a second
tip, the second airfoil being attachable to the aircraft near the first root; and
at least one movable connection attached to at least one of the first airfoil near the
first root and the second airfoil near the second root, the movable connection
being arranged to move at least one of the first airfoil and the second airfoil
10 from a first position with the first tip and second tip near each other to a second
position with the first tip and second tip spaced apart from each other.
2. The system of Claim 1, wherein the movable connection includes a hinge.
3. The system of Claim 1, wherein the movable connection includes a pivot.
- 15 4. The system of Claim 1, wherein the movable connection includes a drive
mechanism arranged to move at least one of the first airfoil and the second airfoil between
the first position and the second position.
5. The system of Claim 1, wherein the movable connection is further arranged to
move at least one of the first airfoil and the second airfoil in a first direction approximately
20 perpendicular to at least one of the first chord and the second chord.
6. The system of Claim 1, wherein the movable connection is further arranged to
move at least one of the first airfoil and the second airfoil in a second direction
approximately parallel to at least one of the first chord and the second chord.
7. The system of Claim 1, further comprising at least one aerodynamic control surface
25 arranged to move at least one of the first airfoil and the second airfoil between the first
position and the second position.
8. The system of Claim 1, wherein the first span is substantially parallel to the second
span in the first position.
9. The system of Claim 1, wherein the first span is at an acute angle to the second span
30 in the second position.



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10. The system of Claim 1, wherein the first airfoil and the second airfoil form a single airfoil in the first position.

11. A method for morphing a lifting surface, the method comprising:
attaching a first airfoil having a first root, a first chord, and a first tip to an aircraft
5 near the first root;
attaching a second airfoil having a second root, a second chord, and a second tip to
the aircraft near the first root; and
rotating at least one of the first airfoil around the first root and the second airfoil
around the second root from a first position with the first and second tips near
10 each other to a second position with the first and second tips spaced apart from
each other than the first position.

12. The method of Claim 11, wherein rotating includes moving at least one of the first airfoil and the second airfoil in a first direction approximately perpendicular to at least one of the first chord and the second chord.

13. The method of Claim 11, wherein rotating includes moving at least one of the first airfoil and the second airfoil in a second direction approximately parallel to at least one of the first chord and the second chord.

14. The method of Claim 11, wherein rotating includes hinging at least one of the first airfoil and the second airfoil.

15. The method of Claim 11, wherein rotating includes pivoting at least one of the first airfoil and the second airfoil.

16. A morphing airfoil system for an aircraft, the system comprising:
a first airfoil having a first root, a first span, a first chord, and a first tip, the first
airfoil being attachable to an aircraft near the first root;
25 a second airfoil having a second root, a second span, a second chord, and a second
tip, the second airfoil being attachable to the aircraft near the first root;
an endplate having a first end, a second end, and a third span between the first end
and second end, the endplate being attached to the first airfoil with the first end
near the first tip and being attached to the second airfoil with the second end
30 near the second tip; and



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5 at least one movable connection attached to at least one of the first airfoil near the first root and the second airfoil near the and the second root, the movable connection being arranged to move at least one of the first airfoil and the second airfoil from a first position with the first span substantially parallel to the second span to a second position with the first span at an acute angle to the second span.

17. The system of Claim 16, wherein the movable connection includes a hinge.

18. The system of Claim 16, wherein the movable connection includes a pivot.

10 19. The system of Claim 16, wherein the movable connection includes a drive mechanism arranged to move at least one of the first airfoil and the second airfoil between the first position and the second position.

20. The system of Claim 16, wherein the movable connection is arranged to move at least one of the first airfoil and the second airfoil in a first direction approximately perpendicular to at least one of the first chord and the second chord.

15 21. The system of Claim 16, wherein the movable connection is further arranged to move at least one of the first airfoil and the second airfoil in a second direction approximately parallel to at least one of the first chord and the second chord.

20 22. The system of Claim 16, further comprising at least one aerodynamic control surface arranged to move at least one of the first airfoil and the second airfoil between the first position and the second position.

23. The system of Claim 16, wherein the first span is substantially parallel to the second span in the first position.

24. The system of Claim 16, wherein the first span is at an acute angle to the second span in the second position.

25 25. The system of Claim 16, wherein the endplate includes a third airfoil.

26. The system of Claim 16, wherein the first airfoil, the second airfoil, and the endplate form a single airfoil in the first position.



27. A method for morphing a lifting surface, the method comprising:
attaching a first airfoil having a first root, a first chord, and a first tip to an aircraft
near the first root;
attaching a second airfoil having a second root, a second chord, and a second tip to
an aircraft near the first root;
connecting an endplate to the first airfoil and the second airfoil, the endplate having
a first end, a second end, and a span between the first end and the second end,
the endplate being attached to the first airfoil with the first end near the first tip
and being attached to the second airfoil with the second end near the second tip;
and
rotating at least one of the first airfoil around the first root and the second airfoil
around the second root from a first position with the first span substantially
parallel the second span to a second position with the first span at an acute angle
to the second span.
28. The method of Claim 27, wherein rotating include moving at least one of the first
airfoil and the second airfoil in a first direction approximately perpendicular to at least one of
the first chord and the second chord.
29. The method of Claim 27, wherein rotating includes moving at least one of the first
airfoil and the second airfoil in a second direction approximately parallel to at least one of the
first chord and the second chord.
30. The method of Claim 27, wherein rotating includes hinging at least one of the first
airfoil and the second airfoil.
31. The method of Claim 27, wherein rotating includes pivoting at least one of the first
airfoil and the second airfoil.
32. The method of Claim 27, wherein the first span, the second span, and the third span
substantially form a triangle in the second position.
33. An aircraft with a morphing airfoil, the aircraft comprising:
a fuselage;
at least one engine;
a first airfoil having a first root, a first span, a first chord, and a first tip, the first
airfoil being attached to the fuselage near the first root;

a second airfoil having a second root, a second span, a second chord, and a second tip, the second airfoil being attached to the fuselage near the first root; and at least one movable connection attached to the fuselage and attached to at least one of the first airfoil near first root and the second airfoil near second root, the movable connection being arranged to move at least one of the first airfoil and the second airfoil from a first position with the first span substantially parallel to the second span to a second position with the first span at an acute angle to the second span.

34. The aircraft of Claim 33, wherein the movable connection includes a hinge.

35. The aircraft of Claim 33, wherein the movable connection includes a pivot.

36. The aircraft of Claim 33, wherein the movable connection includes a drive mechanism arranged to move at least one of the first airfoil and the second airfoil between the first position and the second position.

37. The aircraft of Claim 33, wherein the movable connection is arranged to move at least one of the first airfoil and the second airfoil in a first direction approximately perpendicular to at least one of the first chord and the second chord.

38. The aircraft of Claim 33, wherein the movable connection is further arranged to move at least one of the first airfoil and the second airfoil in a second direction approximately parallel to at least one of the first chord and the second chord.

39. The aircraft of Claim 33, further comprising at least one aerodynamic control surface arranged to move at least one of the first airfoil and the second airfoil between the first position and the second position.

40. The aircraft of Claim 33, wherein the first span is substantially parallel to the second span in the first position.

41. The aircraft of Claim 33, wherein the first span is at an acute angle to the second span in the second position.

42. The aircraft of Claim 33, wherein the aircraft includes an unmanned air vehicle.

43. An aircraft with a morphing airfoil system, the comprising:
a fuselage;



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at least one engine;
a first airfoil having a first root, a first span, a first chord, and a first tip, the first
airfoil being attachable to an aircraft near the first root;
a second airfoil having a second root, a second span, a second chord, and a second
tip, the second airfoil being attachable to the aircraft near the first root;
an endplate having a first end, a second end, and a third span between the first end
and second end, the endplate being attached to the first airfoil with the first end
near the first tip and being attached to the second airfoil with the second end
near the second tip; and
at least one movable connection attached to at least one of the first airfoil near the
first root and the second airfoil near the and the second root, the movable
connection being arranged to move at least one of the first airfoil and the second
airfoil from a first position with the first span substantially parallel to the second
span to a second position with the first span at an acute angle to the second
span.

44. The aircraft of Claim 43, wherein the movable connection includes a hinge.

45. The aircraft of Claim 43, wherein the movable connection includes a pivot.

46. The aircraft of Claim 43, wherein the movable connection includes a drive
mechanism arranged to move at least one of the first airfoil and the second airfoil between
the first position and the second position.

47. The aircraft of Claim 43, wherein the movable connection is arranged to move at
least one of the first airfoil and the second airfoil in a first direction approximately
perpendicular to at least one of the first chord and the second chord.

48. The aircraft of Claim 43, wherein the movable connection is further arranged to
move at least one of the first airfoil and the second airfoil in a second direction
approximately parallel to at least one of the first chord and the second chord.

49. The aircraft of Claim 43, further comprising at least one aerodynamic control
surface arranged to move at least one of the first airfoil and the second airfoil between the
first position and the second position.

50. The aircraft of Claim 43, wherein the first span is substantially parallel to the
second span in the first position.



51. The aircraft of Claim 43, wherein the first span is at an acute angle to the second span in the second position.

52. The aircraft of Claim 43, wherein the endplate includes a third airfoil.

53. The aircraft of Claim 43, wherein the first airfoil, the second airfoil, and the endplate form a single airfoil in the first position.

54. The aircraft of Claim 43, wherein the aircraft includes an unmanned air vehicle.

55. A morphing rotating airfoil system for an aircraft, the system comprising:
a hub;

10 a first airfoil having a first root, a first span, a first chord, and a first tip, the first airfoil being attached to the hub near the first root;

a second airfoil having a second root, a second span, a second chord, and a second tip, the second airfoil attached to the hub near the first root;

15 at least one movable connection attached to the hub, the movable connection being attached to at least one of the first airfoil near the first root and the second airfoil near the second root, the movable connection being arranged to move at least one of the first airfoil and the second airfoil from a first position with the first tip and second tip near each other to a second position with the first tip and second tip spaced apart from each other.

56. The system of Claim 55, wherein the movable connection includes a hinge.

20 57. The system of Claim 55, wherein the movable connection includes a pivot.

58. The system of Claim 55, wherein the movable connection includes a drive mechanism arranged to move at least one of the first airfoil and the second airfoil between the first position and the second position.

25 59. The system of Claim 55, wherein the movable connection is arranged to move at least one of the first airfoil and the second airfoil in a first direction approximately perpendicular to at least one of the first chord and the second chord.

60. The system of Claim 55, wherein the movable connection is further arranged to move at least one of the first airfoil and the second airfoil in a second direction approximately parallel to at least one of the first chord and the second chord.



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61. The system of Claim 55, further comprising at least one aerodynamic control surface arranged to move at least one of the first airfoil and the second airfoil between the first position and the second position.

5 62. The system of Claim 55, wherein the first span is substantially parallel to the second span in the first position.

63. The system of Claim 55, wherein the first span is at an acute angle to the second span in the second position.

64. The system of Claim 55, wherein the first airfoil and the second airfoil form a combined airfoil in the first position.

10 65. The system of Claim 55, wherein the hub is attached to a fuselage of an aircraft.

66. The system of Claim 55, wherein the aircraft includes an unmanned air vehicle.

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